

A New Species of *Nannoscincus* Günther (Squamata: Scincidae) from High Elevation Forest in Southern New Caledonia

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ABSTRACT. A new species of *Nannoscincus* from relictual high elevation closed forest is described from southern New Caledonia. This species is most similar in appearance to *Nannoscincus gracilis*, but can be distinguished by its large size and a suite of distinctive scalation characters. Further, it is the only species of *Nannoscincus* recorded as being able to vocalise. The species is known only from closed forest patches on Pic Ningua and adjacent Mt Çidoa at around 1000 m in altitude. The overall extent of this habitat is small, fragmented, and in an area that is actively mined. As such the species is regarded as at risk, and the level of threat as Vulnerable.

Une nouvelle espèce de *Nannoscincus* provenant d'une forêt relique fermée d'altitude est décrite du sud de la Nouvelle-Calédonie. Cette espèce est d'apparence similaire à *Nannoscincus gracilis*, mais peut s'en différencier par sa grande taille et une série de caractères d'écaillure distinctifs. De plus, c'est la seule espèce de *Nannoscincus* capable de vocaliser. Cette espèce n'est connue que des lambeaux de forêt fermée du Pic Ningua et du Mt Çidoa voisin, à environ 1000 m d'altitude. La répartition actuelle de ce type d'habitat est limitée, fragmentée, et localisée dans une zone fortement soumise à l'impact minier. Pour toutes ces raisons, cette espèce est considérée comme sensible et placée à un niveau de menace «vulnérable».

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Recent studies on the endemic lizard fauna of New Caledonia have revealed the presence of species endemic to high elevation forests on various peaks along the length of the island. In the central and northeast ranges two species appear to be found only at elevations greater than 900 m, the diminutive scincid *Nannoscincus rankini* from Mont Aoupinié (Sadlier *et al.*, 2002), and the gecko *Bavayia*

madjo from Mont Panié and Mont Ignambi in the Panié Range (Bauer *et al.*, 2000). The forest at both Mont Aoupinié and the Panié Range is more or less continuously distributed from mid elevation (400 m) to the summits.

By contrast, high elevation forest on the ultramafic peaks in the south and northwest of the island generally are present as isolated patches, separated from lowland forest by

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extensive areas of maquis shrubland, which covers much of the mid and lower elevation slopes of these massifs. Our knowledge of the lizard fauna of forests on the peaks of the southern ultramafic massifs is heavily biased by accessibility. Mont Ouin and Mont Mou in the region of Dumbéa are part of a network of interconnected ranges with peaks over 1000 m elevation. Field research on these mountains has revealed a particularly rich endemic lizard fauna in high elevation forests, including two species of scincid lizard, *Sigaloseps ruficauda* and *Marmorosphax montana* (Sadlier & Bauer, 1999, 2000), and an undescribed gecko (*Bavayia*) restricted to this habitat.

Further to the north isolated patches of high elevation forest occur on the various ultramafic peaks from the Massif du Humboldt north and west to Mont Do, however, most of these are relatively inaccessible and the composition of their lizard faunas is in most instances unknown. Collections made on the ultramafic peaks of Pic Ningua and nearby Mont Çidoa (formerly Mont Sindoa) are particularly interesting. They include not only a suite of species typical of forests on ultramafic soils but also some taxa usually associated with forests on soil types typical of the central and northern ranges. This is, perhaps, not surprising, as these two peaks lie at the extreme northern edge of the large southern ultramafic block that occupies the southern third of New Caledonia (Paris, 1981; Sautter, 1981). Among species in the latter group is a distinctive new species of *Nannoscincus* that is most similar in appearance to *Nannoscincus gracilis*. This new species of *Nannoscincus* is the largest member of the genus and differs from all other members of the genus in having seven, rather than six, upper labial scales.

Materials and methods

Abbreviations. Specimen abbreviations are prefixed as follows: Auckland Museum (AIM); Australian Museum, Sydney (AMS); California Academy of Sciences, San Francisco (CAS); Museum of Comparative Zoology, Harvard (MCZ); Muséum national d'Histoire naturelle, Paris (MNHN).

The full suite of morphological characters listed below were scored for each specimen where possible.

Measurements. The following characters were scored: snout to vent length (SVL)—measured from tip of snout to caudal edge of anal scales; axilla to groin distance—measured from middle of base of forelimb to middle of base of hindlimb; forelimb to snout length—measured from tip of snout to middle of base of forelimb; hindlimb length—measured from middle of base of hindlimb to tip of fourth toe including nail; tail length—unless otherwise stated is measured from caudal edge of anal scales to tip of tail, on complete original tails only as determined radiographs. Body measurements are expressed as percentages of snout to vent length in the taxon accounts.

Scalation. Head scalation generally follows Taylor (1935) as described and figured by Sadlier (1986) and also includes: pre-temporals—enlarged scales following on from supraciliary series and positioned along lateral edge upper secondary temporal and upper anterior edge of primary temporal; post-ocular scales—enlarged scales following on from pre-temporal series along edge of lower eyelid and bordering lower anterior edge of primary temporal and upper edge of penultimate upper labial; post-temporals—

number of scales positioned posterior to lower secondary temporal and ear opening; midbody scale rows—number of longitudinal scale rows around body counted midway between axilla and groin; paravertebral scales—number of scales in a row down the body from first scale posterior of parietal scale to last scale at level of vent opening; fourth finger and toe scales—number of dorsal scales on fourth digit of hand and foot, distal scale contains claw; basal scale of fourth finger is usually present as a single large scale common to the base of the fourth, third, and second finger; basal scale of fourth toe broadly contacts basal scale of adjacent third toe; fourth finger and toe lamellae—number of ventral scales on fourth digit of hand and foot, distal scale contains claw and basal scale is last largely undivided scale at a point level with intersection of third and fourth digits. Bilateral scalation characters were scored on both sides and the mean value used.

Osteology. Radiographs were prepared using a Eresco AS2 X-ray machine to determine phalangeal formulae and the number of presacral vertebrae and postsacral vertebrae (complete original tails only), at exposures of 30 sec at 30 kV.

Species account

The genus *Nannoscincus* has been identified as a member of the Australasian *Eugongylus* group of lygosomine skinks (Greer, 1979). It is distinguished from other genera in the group by a combination of morphological synapomorphies that includes: fusion of the atlantal arches and intercentrum of the first cervical vertebra into a single element; an elongate body with 29 or more presacral vertebrae; phalanges of digits of the forelimbs reduced, with a phalangeal formula of 2.3.4.4.3 or less for the manus (Sadlier, 1990; Bauer & Sadlier, 2000).

The Australian species, *Siaphos maccoyi* Lucas & Frost, 1894, has previously been considered congeneric with the New Caledonian species of *Nannoscincus* by virtue of its sharing a similar pattern of phalanx reduction (Sadlier, 1990). However, this pattern has also been found in the recently described Australian species *Lampropholis elongata* Greer, 1997 and clearly represents a case of independent evolution of this particular character state. This independent derivation calls into question the significance of this character as a unifying synapomorphy for *maccoyi* and the New Caledonian *Nannoscincus*. Further, mitochondrial and nuclear DNA sequence data (S. Smith *et al.*, unpublished data in preparation) are inconsistent with a close relationship between these taxa. We therefore remove the species *maccoyi* from *Nannoscincus*, which we regard as a strictly New Caledonian genus. The formal placement of the Australian species into a separate genus is required and will need additional research in a broad comparative context.

Wells & Wellington (1984) provided a new generic name, *Anepischetos*, for *maccoyi* and a new species, *A. sharmani* (the latter as type species). Subsequently recognizing that the name was preoccupied (*Anepischetos* Smith, 1900; Lepidoptera), Wells & Wellington (1985) proposed a replacement generic name, *Anepischetosia*, and added a new species, *A. brindabellaensis* to the genus. Both *A. sharmani* and *A. brindabellaensis* were subsequently (Shea & Sadlier, 1999) referred to the synonymy of *Nannoscincus maccoyi* due to the inadequacy of the diagnoses for differentiating the three putative species. *Anepischetosia* has precedence



Fig. 1. Paratype of *Nannoscincus garrulus* n.sp. (AMS R163457).

over *Nannoseps* (type species *Saiphos maccayi*) proposed by Sadlier (1990) as a subgenus of *Nannoscincus*, and hence we use the combination *Anepischetosia maccayi* for the Australian species previously referred to *Nannoscincus*.

Within *Nannoscincus* two monophyletic species groups have been recognized on the basis of morphological data (Sadlier, 1990; Sadlier *et al.*, 2002). One group contains the species *N. mariei*, *N. rankini*, *N. greeri*, *N. hanchisteus*, *N. humectus*, *N. exos*, and *N. manaueti* (a recently described species from the Massif de Kopéto), and the other group the species *N. gracilis*, *N. slevini*, and the species described here from Pic Ningua and Mont Çidoa. Although mitochondrial DNA sequence data are equivocal with respect to the monophyly of the first group, that of the latter is well supported (S. Smith *et al.*, unpublished data). The species in this group are all superficially similar in that they have very elongate bodies and a markedly two-toned colour pattern. They also share a suite of distinctive apomorphic characters, two of which, a reduction in the number of phalanges of the third and fourth fingers to yield a phalangeal formula for the manus of 2.3.3.3.3 or less, and a highly elevated number of presacral vertebrae, are unique to this group within the context of all *Nannoscincus*.

***Nannoscincus garrulus* n.sp.**

Figs 1–5

Type material. HOLOTYPE: MNHN 2003.1002 Pic Ningua, 17.0 km south of Nakaré, Province Sud, New Caledonia (21°44'25"S 166°09'21"E), collected by R.A. Sadlier, A.M. Bauer, T. Jackman, & C.C. Austin on 27 September 2002. PARATYPES: AMS R163451–52, CAS 226164–65, MCZ

R183655 same collection data as holotype; AMS R163453–57, CAS 226166–67 Pic Ningua, 17.0 km south of Nakaré, Province Sud, New Caledonia (21°44'36"S 166°09'02"E), collected by R.A. Sadlier, A.M. Bauer, T. Jackman, & C.C. Austin on 26 September 2002.

Additional material. The following specimens referable to *N. garrulus* were collected in wet pit traps on both Pic Ningua and Mont Çidoa in 1993–1995, but do not form part of the type series: AMS R151490–97, R151499–511, R151513–17, R151520–26, R151528–34, R151536–46, AIM 1702, 1704, 1733, 1735–39, 1775–78, 1783–98, 1800–02, 1815–18, 1820–21 from a range of sites ($n = 7$) between 970–1110 m elevation on Pic Ningua; AIM 1703, 1705, 1734, 1799, 1814, 1819 Mont Çidoa (21°44'S 166°13'E).

Diagnosis. *Nannoscincus garrulus* is a large and elongate member of the genus with a two-toned colour pattern on the body (Fig. 1). It can be distinguished from all other members of the genus by the following combination of characters: frontoparietals divided; two loreals, anterior loreal a small semilunar scale positioned off the postero-dorsal edge of the enlarged nasal scale and failing to contact the labials; seven or more upper labial scales; left and right oviduct present in females; lower eyelid “scaled”; ear opening minute; body scales striated; adult dorsal colour two-toned; ear opening positioned four scales posterior to lower secondary temporal; presacral vertebrae 33–34; phalangeal formula for manus 2.3.3.3.3; phalangeal formula for pes 2.3.4.4.3.

The first four characters will distinguish *N. garrulus* from *N. rankini*, *N. greeri*, *N. hanchisteus*, *N. humectus*, *N. exos*, and *N. manaueti*, all of which have fused frontoparietals, a

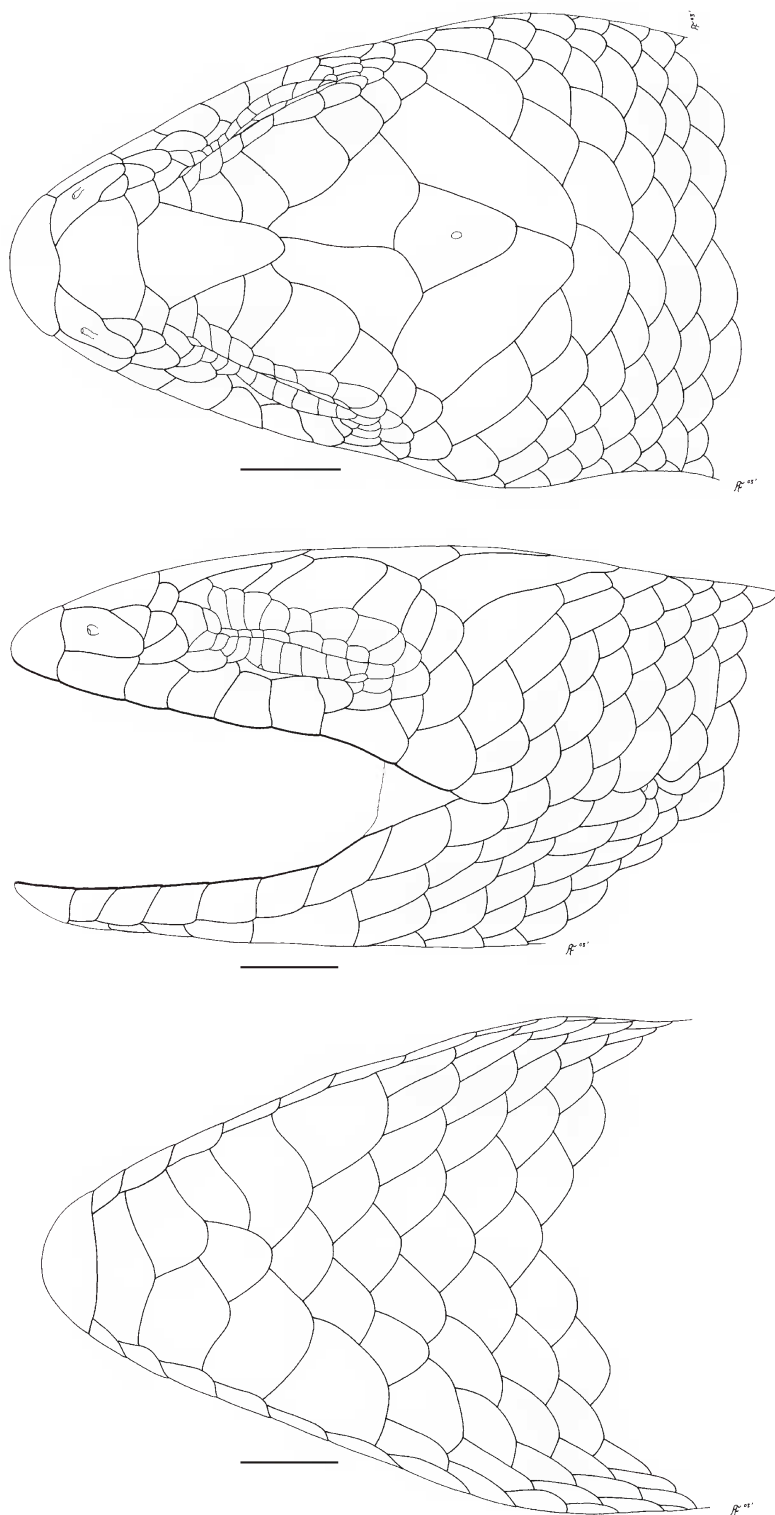


Fig. 2. Dorsal (upper), lateral (middle), and ventral (lower) views of the head of holotype of *Nannoscincus garrulus* n.sp. (MNHN 2003.1002) showing scalation.

single loreal, a windowed lower eyelid, and the oviduct present on the right side only. It can be further distinguished from these species by having fewer phalanges on the third and fourth fingers of the manus.

Nannoscincus mariei is somewhat intermediate between the two morphologically-defined species groups, in

possessing the derived character state of a single loreal and loss of the left oviduct, but retaining the primitive character state of divided frontoparietals. It also has a “scaled” lower eyelid similar to *N. gracilis*, *N. slevini*, and *N. garrulus*, the structure and possible polarity of which has been discussed elsewhere (Sadler, 1990). *Nannoscincus garrulus* is readily

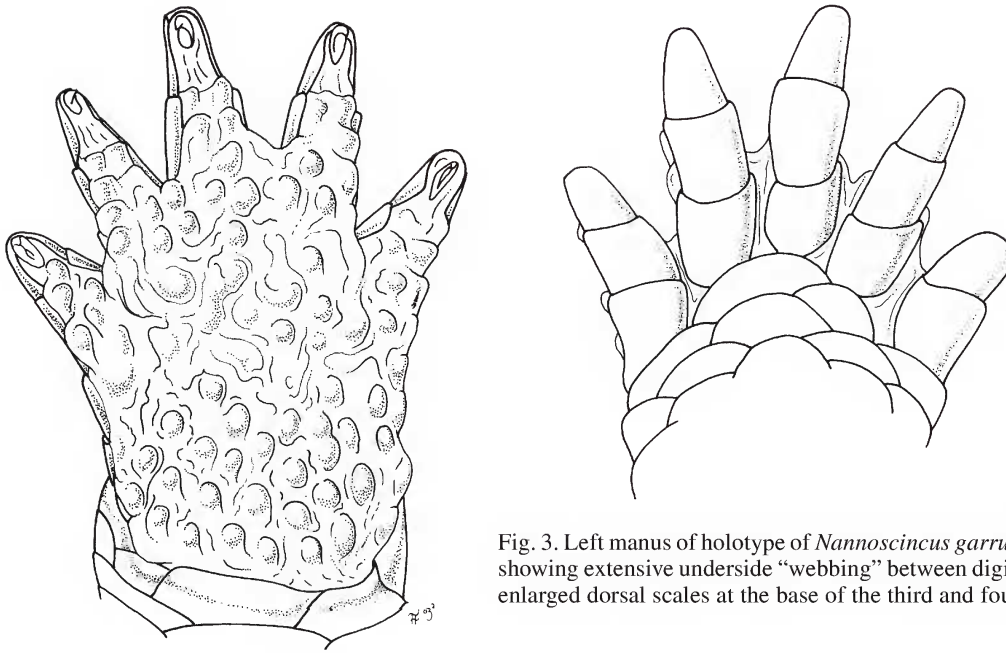


Fig. 3. Left manus of holotype of *Nannoscincus garrulus* n.sp. (MNHN 2003.1002) showing extensive underside “webbing” between digits of the forelimbs (right) and enlarged dorsal scales at the base of the third and fourth digits (left).

distinguished from *N. mariei* by the presence of two (vs one) loreal scales, and the presence of a small but obvious ear opening (vs ear opening absent).

Nannoscincus garrulus most resembles *N. gracilis* and *N. slevini*. It is noticeably larger (maximum SVL 52.5 mm) than either *N. gracilis* (SVL 49.0 mm) or *N. slevini* (SVL 43.0 mm), and has seven or more upper labial scales whereas both *N. gracilis* and *N. slevini* have six. It can be further distinguished

from *N. slevini* by the presence of five (vs four) digits on the manus, and from *N. gracilis* in having more phalanges on the fifth digit of the manus (2.3.3.3.3 vs 2.3.3.3.2).

Etymology. The specific epithet is the Latin word *garrulus*, meaning talkative, and is in reference to the tendency for this species to emit a squeaking sound when distressed (Bauer *et al.*, 2004).

Description. Based on the holotype and 12 paratype specimens comprising six adult males, three adult females, and four subadults—measurements are for adult specimens only. Mean values of certain characteristics are reported

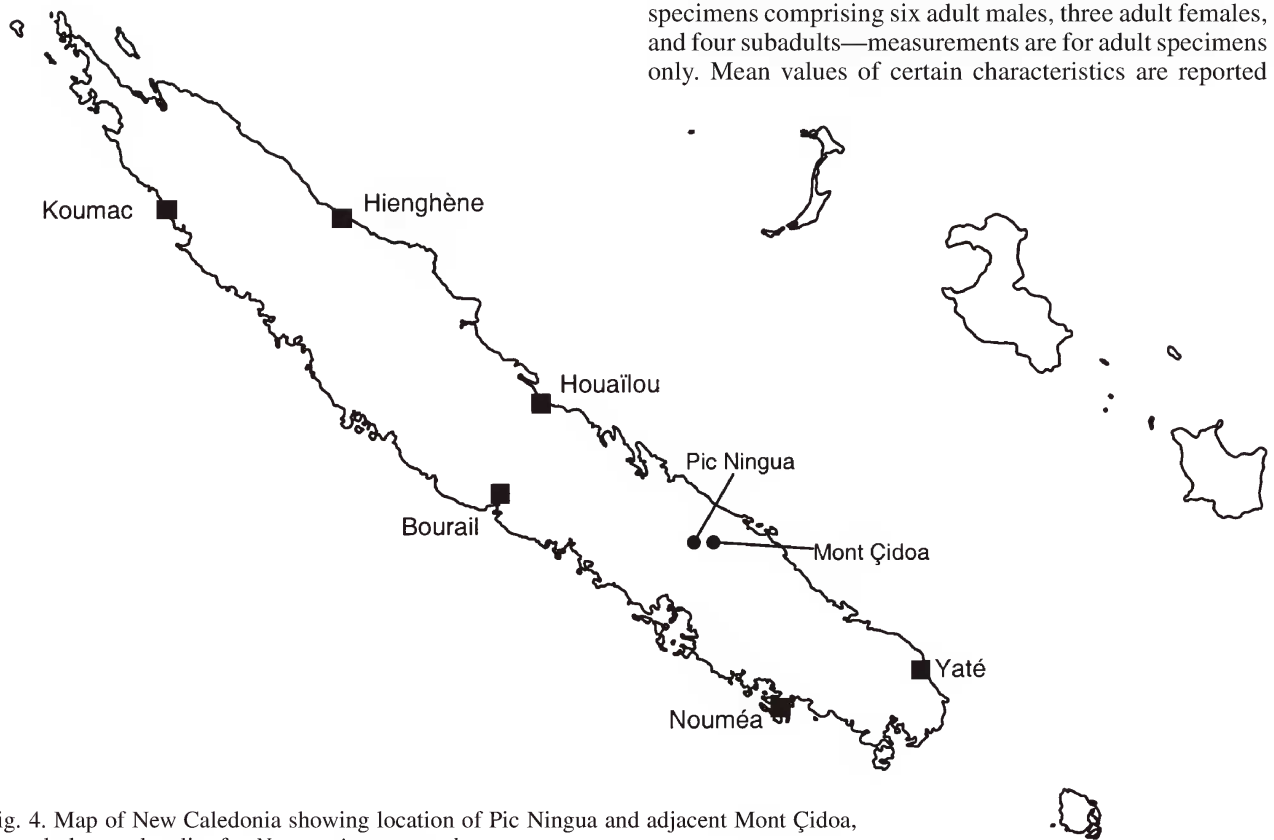


Fig. 4. Map of New Caledonia showing location of Pic Ningua and adjacent Mont Çïdoa, the only known locality for *Nannoscincus garrulus* n.sp.



Fig. 5. Isolated closed forest patch on Mont Çidoa, typical of habitat in the area from which the types of *Nannoscincus garrulus* n.sp. were collected.

with standard deviations. *Measurements*: SVL 45.0–52.5 mm; distance from axilla to groin 64.4–66.7% of SVL (\bar{x} = 65.4); distance from forelimb to snout 28.6–31.3% of SVL (\bar{x} = 29.9); hindlimb length 19.0–22.2% of SVL (\bar{x} = 20.6); tail length 106.1% of SVL (estimated from individual with most complete tail). *Scalation*: Head (Fig. 2): nasals moderately separated, very large and extending laterally along the side of the head; frontonasal broader than long; prefrontals very small and widely separated; supraciliaries 7 (81%), rarely 8, with the first supraciliary contacting frontal (thereby excluding contact between the prefrontal and first supraocular); frontal short, almost as broad as long; supraoculars four; frontoparietals paired; interparietal distinct; parietals each usually bordered by a single nuchal and upper secondary temporal scale (73%) but showing some fragmentation of scales in this region such that nuchals (19%) or upper secondary temporals (8%) are sometimes divided to form two scales; upper labials 7 (96%), rarely 8; lower labials 7; two loreals, anterior loreal reduced to a small semilunar scale positioned off posterodorsal edge of enlarged nasal scale, posterior loreal also semilunar in shape, either contacting the labials narrowly (42%) or excluded from contact by extension of posterior edge of large nasal back to contact lower preocular; single large anterior subocular; pretemporals two; postoculars 3 (77%) or 4; primary temporal single (46%), or divided to form two similar sized scales; upper secondary temporals usually single (92.7%), occasionally divided to form two scales; lower secondary temporals single; tertiary temporals two; postlabials two; ear opening positioned four scales posterior

to lower secondary temporal; postmental contacting first and second lower labial; chinshields three, first pair in broad contact. *Body*: scales striated, midbody scale rows 22–24 (\bar{x} = 22.8 \pm 1.01); paravertebral scales 60–73 (\bar{x} = 66.7 \pm 3.5). *Limbs*: scales on top of fourth finger 4–5 (\bar{x} = 4.05 \pm 0.14); lamellae beneath fourth finger 4–5 (\bar{x} = 4.1 \pm 0.30), rudimentary interdigital webbing at base of fingers (Fig. 3); scales on top of fourth toe 6–7 (\bar{x} = 6.05 \pm 0.14), the basal scale present as a large scale at base of third and fourth toes; lamellae beneath fourth toe 13–16 (\bar{x} = 13.77 \pm 0.83). *Osteology*: presacral vertebrae 33 or 34 (54%, n = 13); postsacral vertebrae 37–38 (n = 2) phalangeal formula for manus and pes 2.3.3.3.3 and 2.3.4.4.3 (n = 13), respectively.

Colouration (in preservative): dorsal colour light to mid brown, with scattered dark flecks aligned along vertebral axis to form a broken longitudinal line; nape with a variably defined pale blotch with a dark posterior edge. Lateral surface noticeably darker than dorsal, unmarked. Dorsal and lateral surfaces defined by a dark brown to black (darker than lateral colour) dorsolateral stripe, pale-edged above. Dark dorsolateral stripe extends from back of eye (inflected over tympanic region) to level of hindlimbs, breaking up and becoming poorly defined along tail. Head slightly darker at sides than adjacent areas of body, dark colouring extending around lower edge of rostral scale and inflecting upwards to form a dark midrostral streak in boldly marked individuals, subocular labials with pale markings. Ventral surface pale with a light to heavy concentration of scattered brown markings at edges and regular brown markings to throat region.

Distribution and habitat. At present known only from Pic Ningua and Mont Çïdoa, at the northern edge of the extensive ultramafic block that covers much of the southern third of New Caledonia (Fig. 4). Closed forest habitat (Fig. 5) is restricted to the top of these mountains from about 900 m elevation. All specimens were collected under logs and rocks in the vicinity of a small, shallow gully. The forest floor was generally dry at the time of collection, the island not having had significant rainfall since the previous wet season (January–March). The apparent absence of individuals away from the gully could indicate the species concentrates in areas where soil moisture is present, such as the gullies, during periods of seasonal dryness. Like all members of the genus, *N. garrulus* is highly desiccation-prone (Bauer & Sadlier, 2000).

The nearest records of the allied *Nannoscincus gracilis* are from mid elevation forest at Col de Nassirah (348 m) 10 km to the south and west, and Col de Petchécara (435 m) 15 km to the north and east, whereas *N. slevini* has been recorded from Mt Canala and Plateau de Dogny 25 km to the north and east.

Natural history. All specimens made faint but distinctive squeaks when handled, presumably as a defensive measure (Bauer *et al.*, 2004). This is the only *Nannoscincus*, and only New Caledonian scincid, for which vocalization has been documented (under the name *N. cf. gracilis*—Bauer *et al.*, 2004). One adult female collected in January, the summer wet season, contained two large yolked oviducal eggs (one in the left oviduct and one in the right), and another specimen two large yolked ovarian follicles.

Conservation status. *Nannoscincus garrulus* has an extremely restricted distribution, being known only from the type locality at Pic Ningua and adjacent Mont Çïdoa. That it was not recorded from high elevation on forest on nearby Mt Do indicates the species is not necessarily likely to be more widely distributed. Closed forest habitat occurs at Bwa Bwi (19 km ESE of Pic Ningua and 9 km SSE of Mont Çïdoa) and possibly Dent de St-Vincent (20 km SSE of Pic Ningua), both of which lie along a more or less continuous high elevation ridge. However, neither site has yet been surveyed. The size of high elevation forest patches in this area of the southern ultramafic block is extremely small, especially on Pic Ningua and Mont Çïdoa.

The forest on Pic Ningua has been set aside as a special reserve. An access road to the mining operation passes along one edge of the forest. Given the very steep relief of the terrain and the small size of the forest patches, any mining activity through or adjacent to the forest has the potential to alter a significant proportion of the overall area of the forest. The mid slopes of the ranges in this part of the island are covered with maquis, and there is a very narrow transition zone between this and the high elevation closed forest. Frequent burning of maquis shrubland, particularly in areas near settlement or development, and its impact upon the forest edge is considered a significant threat to the overall size and quality of isolated closed forest patches in New Caledonia (Fig. 5).

Given the species' highly restricted distribution, the relatively small size of the remaining moist forest on Pic Ningua and Mont Çïdoa, and the threat to this habitat from fire, the species would be ranked as Endangered under a modified IUCN classification system (Sadlier & Bauer, 2003) where area of occupancy <100 km², number of populations = 2, and there is an apparent continuing decline in area, extent and/or quality of habitat.

Relationships. A previous scheme of relationships for *Nannoscincus* (Sadlier, 1990) identified two groups, the *N. gracilis* group comprising *N. gracilis* + *N. slevini*, and the *N. mariei* group comprising the species *N. mariei* + *N. rankini* + *N. greeri*. The species *N. hanchisteus*, *N. humectus*, and *N. exos* were subsequently added to the latter group (Sadlier *et al.*, 2002), and later *N. manaueti* (Sadlier *et al.*, 2004).

The *N. mariei* group is a well diagnosed clade, characterized by loss of the left oviduct in females, loss of the anterior loreal scale, and a reduced number of lower labial scales. The *N. gracilis* group also constitutes a clade characterized by a reduction in the number of phalanges in the third and fourth digits of the manus, a pattern of scale reduction in the loreal region resulting in both the anterior and posterior loreals being reduced to small semilunar scales, and a tendency towards greater elongation of the body as seen in the greatly increased number of presacral vertebrae.

Nannoscincus garrulus is clearly a member of the *N. gracilis* group. It is also very distinct from either *N. gracilis* or *N. slevini* in having a number of unusual scalation characteristics including: fragmentation in the region of the primary temporal such that two scales rather than one are often present; fragmentation in the region of the nuchal such that two or more scales rather than one are sometimes present; an increased number of post temporal scales such that four, rather than three or fewer, scales occur between the lower secondary temporal and the ear opening; a tendency for displacement of the posterior loreal by contact between the lower preocular and nasal to exclude contact between the posterior loreal and upper labial scales on occasions; an increased number of lower labial scales such that seven scales border the lip between the mental scale and angle of the jaw; and the presence of seven upper labial scales with three rather than two labial scales positioned below the eye in the area between the anterior preocular scale and postsubocular scales (the fourth wholly bordering the lower eyelid, the third and fifth partially). It is likely that the condition seen in *N. garrulus* for the first three of these characters is apomorphic. The polarity of the upper labial scale character in *N. garrulus* is, however, less clear. All other species of *Nannoscincus* tend to have only two scales (more or less similar in size) positioned immediately below and wholly or partially bordering the lower eyelid. It is possible the extra upper labial bordering the lower eyelid of *N. garrulus* is derived from a division of one of the two upper labial scales usually seen in other species of *Nannoscincus* that are positioned immediately below and bordering the lower eyelid.

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